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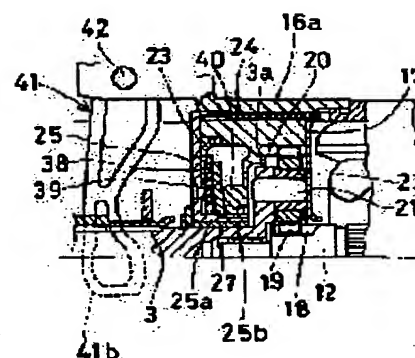
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## (54) STARTER WITH EPICYCLIC REDUCTION GEAR

(57)Abstract:

**PROBLEM TO BE SOLVED:** To suppress wear of the contact parts which cause a relative rotation to come into contact with each other when the internal gear rotates due to the function of a shock absorber.

**SOLUTION:** An internal gear 20 of the epicyclic reduction gear 5 is connected with a first wearing plate 23 of the shock absorber to be prevented from rotating by the first wearing plate 23. However, a predetermined gap is provided between the outer circumferential surface of the internal gear 20 and the inner circumferential surface of the cylindrical wall part 16a of the housing to allow the internal gear 20 to rotate when the shock absorber is put in operation. Further, a metallic annular member 24 is disposed in the gap. The annular member 24 is disposed rotatably relatively to the cylindrical wall part 16a and the internal gear 20. That is, a minute gap is provided between the annular member 24 and the cylindrical wall part 16a and between the annular member 24 and the internal gear 20 respectively.



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**CLAIMS**

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[Claim(s)]

[Claim 1] The starter with an epicycle reduction gear characterized by providing the following. The starting motor which generates turning effort in an armature in response to energization. The epicycle reduction gear which has the sun gear prepared in the axis of rotation of the aforementioned armature, the planet gear which gears to this sun gear, and the internal gear which gears to the aforementioned planet gear, and slows down rotation of the aforementioned armature. The output shaft by which a rotation drive is carried out through this epicycle reduction gear at the aforementioned starting motor. The pinion which transmits the turning effort which this output-shaft top was prepared possible [ an attitude ] through the helical spline, geared with the starter ring of an engine, and was transmitted to the aforementioned output shaft to the aforementioned starter ring, The impact-absorption equipment which is made to rotate the aforementioned internal gear and eases the aforementioned impulse force when predetermined impulse force joins the aforementioned epicycle reduction gear, Housing which has a crevice and contains the aforementioned epicycle reduction gear between the peripheral faces of the aforementioned internal gear, Approximate circle cylinder part material which was allotted to the crevice formed between the inner skin of the aforementioned housing, and the peripheral face of the aforementioned internal gear, and was prepared possible [ the aforementioned housing and the aforementioned internal gear, and relative rotation ].

[Claim 2] it has the following and the aforementioned approximate circle cylinder part material is allotted between the aforementioned curtain boards and the aforementioned center cases which counter shaft orientations -- having -- the shaft-orientations length of the aforementioned approximate circle cylinder part material -- the shaft-orientations distance between the aforementioned curtain board and the aforementioned center case, and abbreviation -- the starter with an epicycle reduction gear according to claim 1 characterized by being prepared identically The curtain board which is allotted between the aforementioned epicycle reduction gear and the aforementioned armature, and interrupts between both. The center case supported free [ rotation of the end side of the aforementioned output shaft ] while being allotted to the aforementioned pinion side of the aforementioned impact-absorption equipment and being prepared impossible [ rotation ] to the aforementioned housing.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the starter equipped with the epicycle reduction gear which slows down rotation of a starting motor.

[0002]

[Description of the Prior Art] In recent years, the loading space is carrying out densification of the engine room of vehicles by the increase in the auxiliary machinery held etc., and the miniaturization of a starter has been advanced as part of the countermeasure. The miniaturization of a starter corresponds by preparing a reduction gear in the interior of a starter, and considering as a small high-speed motor. In this case, a motor is further miniaturized by raising a reduction gear ratio, and the example as which a reduction gear also adopts the epicycle reduction gear with which a high reduction gear ratio is obtained comparatively is conspicuous. Moreover, in order to attain the further miniaturization, miniaturizing the reduction gear section is also considered and there is an idea of attaining the miniaturization of this reduction gear section, in an epicycle reduction gear by packing the space formed by the periphery of the internal gear at the outermost part of the reduction gear section, and the inner circumference of housing which stores the internal gear.

[0003] However, in the starter equipped with impact-absorption equipment, if it rotates after the internal gear has carried out eccentricity by the backlash between each gear etc. since an internal gear is the structure rotated to housing when predetermined impulse force joins an epicycle reduction gear, the case where the peripheral face of an internal gear grinds the inner skin of housing will arise. In such a case, by housing generally formed by the aluminium alloy etc., for example, and the internal gear made of a resin which blended the glass fiber for on-the-strength reservation, since it tends to wear the direction of housing out, when the peripheral face of an internal gear grinds the inner skin of housing, the wear powder of aluminum is generated. Consequently, housing carried out thinning, the on-the-strength fall was caused and there was a possibility that an allophone might occur because the wear powder of housing invades into bearing or the engagement section of a reduction gear.

[0004] Then, the spring ring with which the wave was formed, respectively between the inner skin of housing and the peripheral face of an internal gear and between the inner skin of a planet gear and the peripheral face of the support shaft of a planet gear is made to intervene in the starter indicated by JP,63-266166,A. Thereby, even if an internal gear carries out eccentricity, by elasticity operation of each spring ring, rocking operation of an internal gear and a planet gear is attained to each axis, and ideal engagement of each gear can be obtained.

[0005]

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional technology, since the spring ring is carrying out abbreviation quiescence to housing by own elasticity operation, relative change arises between a spring ring and an internal gear by rotation of an internal gear. For this reason, it is not avoided that wear arises in both (a spring ring and internal gear) contact section. this invention was accomplished based on the above-mentioned situation, and the purpose is in offering the starter with an epicycle reduction gear which can reduce wear of the contact section which produces relative rotation and contacts, when an internal gear rotates by operation of impact-absorption equipment.

[0006]

[Means for Solving the Problem] According to invention of a claim 1, the approximate circle cylinder part material allotted to the crevice formed between the inner skin of housing and the peripheral face of an internal gear is prepared possible [ relative rotation ] to housing and the internal gear. If approximate circle cylinder part material carries out relative rotation to an internal gear and housing by this when an internal gear rotates by operation of impact-absorption equipment, the relative rotational frequency difference of housing and approximate circle cylinder part material and the

relative rotational frequency difference of approximate circle cylinder part material and an internal gear will become small from the relative rotational frequency difference of an internal gear and housing. For this reason, even if the peripheral face of approximate circle cylinder part material and the inner skin of housing contact with the eccentricity of an internal gear and it wears the contact section out, or even if the inner skin of approximate circle cylinder part material and the peripheral face of an internal gear contact and it wears the contact section out, wear of the contact section can be reduced conventionally (when the peripheral face of an internal gear and the inner skin of housing contact).

[0007] according to invention of a claim 2 -- the shaft-orientations length of approximate circle cylinder part material - the shaft-orientations distance between a curtain board and a center case, and abbreviation -- it is prepared identically. Thereby, approximate circle cylinder part material can serve as the duty of a spacer which secures the interval of the shaft orientations of a curtain board and a center case. Moreover, since approximate circle cylinder part material is arranged between a curtain board and a center case, even when a pinion gears with a starter ring and a center case is pressed by operation of a helical spline through an output shaft to a starting motor side, the effect that it can prevent that a center case moves to a curtain-board side is also produced.

[0008]

[Embodiments of the Invention] Next, the starter of this invention is explained based on a drawing.

(The 1st example) Drawing 1 is the important section cross section of a starter 1. The starting motor 2 by which the starter 1 of this example generates turning effort in response to energization, the epicycle reduction gear which slows down rotation of this starting motor 2 (it mentions later), The impact-absorption equipment which absorbs the excessive torque which joins the drive system of an one way clutch 5 and a starter 1 which transmits turning effort to a pinion 4 through this reduction gear from the pinion 4 which was able to establish the output-shaft [ by which a rotation drive is carried out ] 3, and output-shaft 3 top in the starting motor 2 possible [ movement to shaft orientations ], and an output shaft 3 (it mentions later), And while performing energization control of the starting motor 2, it consists of magnet-switch 6 grades which generate the knockout force of a pinion 4.

[0009] The starting motor 2 is the direct current motor of the common knowledge which consisted of armature 9 grades allotted to the yoke [ of a cylindrical shape ] 7, field equipment [ which was fixed to the inner skin of this yoke 7 ] 8, and inner circumference side of the field equipment 8. An armature 9 consists of the armature core 10, the armature coil 11 held at this armature core 10, and the shaft 12 pressed fit in the center section of the armature core 10, is supported free [ rotation ] through the bearing 13 by which the end side (left end side of drawing 1 ) of the shaft 12 was arranged in the other end side crevice of an output shaft 3, and is supported by the end cover 14 free [ rotation ] through the bearing which an other end side does not illustrate. An end cover 14 is a wrap thing and housing 16 concludes other end side opening of a yoke 7 with the yoke 7 by two or more through bolts 15. Moreover, the curtain board 17 which interrupts between an armature 9 and reduction gears is allotted to the end side of a yoke 7, and the periphery section of the curtain board 17 is positioned in respect of the end side edge of a yoke 7.

[0010] As shown in drawing 2 , a reduction gear consists of a sun gear 18 formed in the end side periphery of a shaft 12, two or more planet gears 19 which gear to this sun gear 18, and an internal gear 20 which gears to each planet gear 19, and is held in cylinder wall 16a of housing 16. Rotation of a shaft 12 is transmitted to each planet gear 19 because a sun gear 18 rotates to a shaft 12 and one. Each planet gear 19 is supported free [ rotation ] through bearing 22 by the pin 21 by which pressing fixation was carried out at flange 3a prepared in the other end periphery of an output shaft 3, gears with a sun gear 18 and the internal gear 20, and it revolves around the sun, rotating the periphery of a sun gear 18. The internal gear 20 engages with the 1st file plate 23 of impact-absorption equipment, and rotation regulation is carried out with the 1st file plate 23. However, when impact-absorption equipment operates, between the peripheral face of the internal gear 20, and the inner skin of cylinder wall 16a of housing 16, the predetermined crevice is secured so that the internal gear 20 can be rotated.

[0011] Moreover, as shown also in drawing 2 (important section expanded sectional view of drawing 1 ), the annular member 24 (approximate circle cylinder part material of this invention) made from the metals (for example, tool steel, high-carbon steel, etc.) of a high degree of hardness is arranged in the above-mentioned crevice. This annular member 24 is allotted possible [ relative rotation ] to cylinder wall 16a and the internal gear 20. That is, the respectively minute crevice is secured between the annular member 24 and cylinder wall 16a and between the annular member 24 and the internal gear 20. In addition, the annular member 24 can consider the shape of a cylindrical shape as shown in drawing 3 (a), the configuration in which notching 24a is prepared in a part of circumferential direction as shown in drawing 3 (b), the configuration made into the circumferential direction as shown in drawing 4 (a) 2 \*\*\*\*s, the shape of a cylindrical shape which were made into shaft orientations as shown in drawing 4 (b) 2 \*\*\*\*s, etc. moreover, the shaft-orientations distance between the above-mentioned curtain board 17 a little with the length of the shaft orientations of the annular member 24 longer than the shaft-orientations length of the internal gear 20, and the below-mentioned

center case 25 and abbreviation -- it is prepared identically In addition, housing 16 is a product made from an aluminium alloy to the metal annular member 24, and the internal gear 20 is a product made of a resin containing a glass fiber.

[0012] An output shaft 3 is allotted to a shaft 12 and the same axle by the one side of an armature 9, the end is supported by housing 16 free [ rotation ] through bearing 26, and the other end side is supported by container-liner section 25a of the center case 25 free [ rotation ] through bearing 27. The center case 25 is positioned in joggle 16b by which the periphery section was prepared in housing 16, and rotation regulation is carried out at housing 16. A pinion 4 gears with the starter ring 28 of an engine, transmits the turning effort of the starting motor 2 to a starter ring 28, and has fitted into the periphery of an output shaft 3 through bearing 29. In addition, the end side periphery of an output shaft 3 is equipped with the stop collar 30 which regulates advance movement of a pinion 4.

[0013] The one way clutch 5 consists of the inner 31, an outer 32, a roller 33, and clutch-cover 34 grade. The inner 31 was formed in a pinion 4 and one by the other side of a pinion 4, and has fitted into the periphery of an output shaft 3 through bearing 35. Coaxial arrangement is carried out at the periphery of an inner 31, and an outer 32 has the cam room (not shown) of the shape of two or more wedge in the inner skin, and is prepared in the spline cylinder part 36 and one which fit into an output shaft 3 through helical spline 3b. A roller 33 is contained by the cam room and energized in the narrow direction of a cam room with the spring which is not illustrated. A clutch cover 34 covers the periphery of the plate 37 which regulates movement of the shaft orientations of a roller 33, and an outer 32, and is fixing the outer 32 and the plate 37.

[0014] Impact-absorption equipment consists of the 1st aforementioned file plate 23, the 2nd file plate 38, a disk spring 39, and regulation screw 40 grade, as shown in drawing 2 . In response to the energization force of a disk spring 39, friction engagement of the 1st file plate 23 is carried out with the center case 25 and the 2nd file plate 38 through the 2nd file plate 38. The regulation screw 40 is screwed on external thread part 25b formed in the container-liner section 25a periphery of the center case 25, and is adjusting the energization force of a disk spring 39. Although this impact-absorption equipment has regulated rotation of the 1st file plate 23 according to the friction engagement force with the 1st file plate 23, the center case 25, and the 2nd file plate 38, if the excessive torque exceeding the quiescence torque produced according to the friction engagement force joins a drive system, the 1st file plate 23 will rotate with the internal gear 20, and it will absorb excessive torque.

[0015] A magnet switch 6 drives a shift lever 41 with the plunger suction force while the plunger (not shown) arranged on the inner circumference of a coil by energizing the coil (not shown) to build in and generating magnetism will be attracted and it will close an internal contact (not shown), if the starting switch which is not illustrated is turned on. Arm 41a and leg 41b are prepared in a rockable focusing on the supporting point 42 prepared in housing 16, a shift lever 41 engages with the joint 43 by which the arm 41a was connected with the plunger, and leg 41b is engaging with the periphery of the spline cylinder part 36.

[0016] Next, the operation of this example is explained. If the coil in a magnet switch 6 is energized by ON operation of a key switch and a plunger is attracted by it, a shift lever 41 will rock the supporting point 42 as a center. A pinion 4 moves an output-shaft 3 top to a starter-ring 28 side with an one way clutch 5 by extruding by this the spline cylinder part 36 which engages with leg 41b of a shift lever 41 along with helical spline 3b in an output-shaft 3 top.

[0017] On the other hand, if the internal contact of a magnet switch 6 closes with movement of a plunger, electric power is supplied by the starting motor 2 from a battery, and turning effort occurs in an armature 9, and rotation of the armature 9 will be slowed down with a reduction gear, and will be transmitted to an output shaft 3. After rotation of an output shaft 3 is transmitted to an outer 32 through the spline cylinder part 36, an inner 31 and the pinion 4 which accomplishes one rotate it by being further transmitted to an inner 31 through a roller 33 from an outer 32. An engine is put into operation by a pinion 4 gearing with a starter ring 28, and transmitting the turning effort of the starting motor 2 to a starter ring 28 by this.

[0018] After engine starting, if a pinion 4 is turned by the engine through a starter ring 28 and the rotational speed of an inner 31 becomes larger than the rotational speed of an outer 32, a roller 33 will resist the energization force of a spring and will move to the method of latus of a cam room. Thereby, since engagement to a roller 33, an outer 32, and an inner 31 is canceled, rotation of an inner 31 is not transmitted to an outer 32, and overrun of an armature 9 can be prevented. If starting of an engine is completed and a starting switch is turned off, the energization to a coil will stop and a plunger will return to an initial valve position. While the internal contact of a magnet switch 6 opens and the electric supply to an armature 9 is stopped by this, when a shift lever 41 rocks to the time of engine starting, and an opposite side focusing on the supporting point 42, it secedes from a starter ring 28, and with an one way clutch 5, a pinion 4 retreats an output-shaft 3 top, and returns to a static position (position shown in drawing 1 ).

[0019] When the speed which collides with the gear tooth of the dentation starter ring 28 of a pinion 4 in process in which the above-mentioned pinion 4 gears to a starter ring 28 is early, a high shock occurs between a pinion 4 and a

starter ring 28. In order that the 1st file plate 23 connected with the internal gear 20 may be slippery to the center case 25 and the 2nd file plate 38 if the torque which joins the drive system of a starter 1 by this shock reaches predetermined torque (namely, when excessive torque is added), the internal gear 20 is also rotated with the 1st file plate 23. If it rotates after the internal gear 20 has carried out eccentricity by the backlash prepared between each gear of a reduction gear at this time, it will rotate relatively to the annular member 24, contacting the inner skin of the annular member 24 by which the peripheral face of the internal gear 20 was arranged between cylinder wall 16a of housing 16, and the internal gear 20. Moreover, since it is prepared possible [ relative rotation ] to cylinder wall 16a of housing 16, the annular member 24 can be taken to rotation of the internal gear 20, and can be rotated.

[0020] (Effect of this example) Since the annular member 24 is the metal of a high degree of hardness even if it rotates relatively to the annular member 24, while the internal gear 20 contacts the annular member 24, the starter 1 of this example can suppress wear of the contact section of the internal gear 20 and the annular member 24. Moreover, even if cylinder wall 16a of housing 16 rotates after the internal gear 20 has carried out eccentricity since contact on the internal gear 20 is avoided by the annular member 24, it is not ground by the internal gear 20, and can prevent wear of cylinder wall 16a. In addition, although it may also happen to wear out the contact section of cylinder wall 16a and the annular member 24 when the annular member 24 takes to rotation of the internal gear 20 and carries out the surroundings Since rotation of the annular member 24 is intermittent, while the annular member 24 contacts to cylinder wall 16a smaller [ the rotational speed of the annular member 24 ] than the rotational speed of the internal gear 20, even if it rotates, it can be said that there is little wear of cylinder wall 16a.

[0021] Moreover, since the wear of both contact sections which carries out relative rotation can be reduced and the crevice between the inner skin of cylinder wall 16a and the peripheral face of the internal gear 20 can be made small as much as possible, the outer diameter of the part and cylinder wall 16a can be made small. Since two or more holes which are in the flange for starter attachment prepared in housing 16 by this, or the pitch of a stud bolt can be taken more narrowly than before, the anchoring flexibility of a starter 1 improves.

[0022] furthermore -- according to this example -- the shaft-orientations length of the annular member 24 -- the shaft-orientations distance between a curtain board 17 and the center case 25, and abbreviation -- it is prepared identically Thereby, the annular member 24 can serve as the duty of a spacer which secures the interval of the shaft orientations of a curtain board 17 and the center case 25. Moreover, since the annular member 24 is arranged between a curtain board 17 and the center case 25, even when a pinion 4 gears with a starter ring 28 and the center case 25 is pressed by operation of helical spline 3b through an output shaft 3 to the starting motor 2 side, the effect that it can prevent that the center case 25 moves to a curtain-board 17 side by the annular member 24 is also produced.

[0023] (The 2nd example) Drawing 5 is the important section expanded sectional view of a starter 1. As the 1st example differs from the structure of impact-absorption equipment and the starter 1 of this example is shown in drawing 5, the elastic bodies 44, such as rubber, intervene between the internal gear 20 and the 1st file plate 23. According to the structure of this example, when excessive torque joins the drive system of a starter 1, the 1st file plate 23 can absorb excessive torque like the 1st example by resisting the friction engagement force with the center case 25 and the 2nd file plate 38, and sliding. Moreover, although the 1st file plate 23 is not slippery to shocking torque smaller than excessive torque, shocking torque is absorbable because an elastic body 44 deforms between the 1st file plate 23 and the internal gear 20 (it bends). the crevice secured between cylinder wall 16a of housing 16, and the internal gear 20 also in this example -- the annular member 24 -- arranging -- and the length of the shaft orientations of the annular member 24 -- the shaft-orientations distance between the center case 25 and a curtain board 17, and abbreviation -- it cannot be overemphasized by making it the same that the same effect as the 1st example can be acquired

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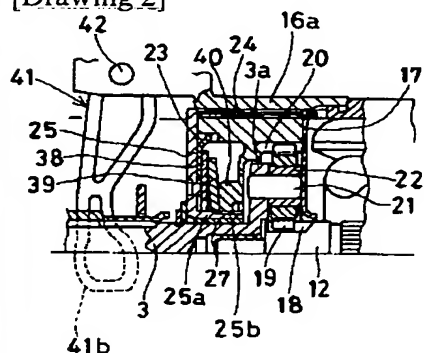
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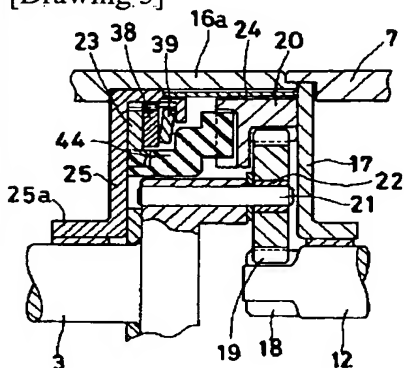
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## DRAWINGS

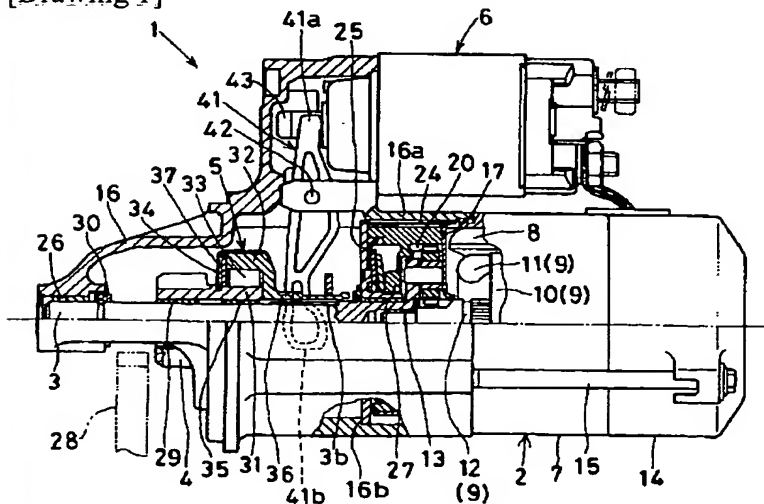
[Drawing 2]



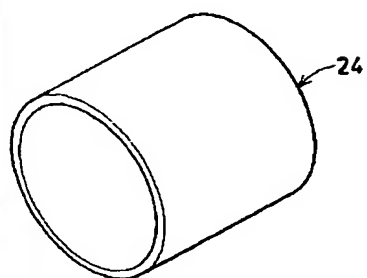
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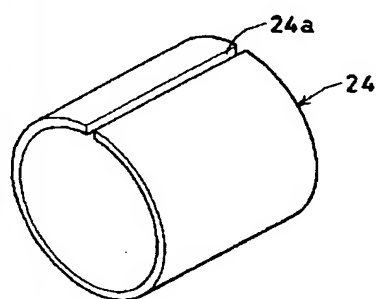
[Drawing 1]



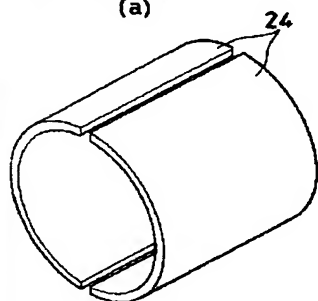
[Drawing 3]  
(a)



(b)



[Drawing 4]  
(a)



(b)

